# Characterization of Leaching for Fixation of Contaminated Soil

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## 1. Introduction

In recent years, the soil contaminations with radioactive materials have been occurred by accidents of nuclear power plant. It was serious environmental problems that radioactive leaks polluted in the air, water, soil and residential area.

According to the analyzed results for radioactive contamination of the soil around Chernobyl, it has been reported that 60 % of the radioactivity concentrated within 5-8 cm of the soil surface [1, 2]. The presence of such radioactivity may hazards to human or the environment. Therefore, proper characterization and remediation may be requirement in order to reduce the radiological hazards to acceptable levels. Therefore many methods have been developing for soil fixation to prevent the diffusion of pollutants. One of methods is a soil fixation by using polyelectrolyte which is charged polymers and make polymer complexes with soil [3, 4].

The method can prevent a spread of radioactive material by floating on the soil surface. Also it can prevent radioactive materials spread by water flowing into the contaminated soil which was fixed by polymer.

In this study, we investigated the particle size distributions of the soil around nuclear power plants for soil fixation. Also we analyzed the characteristics of leaching in the fixed soil to define the influence of diffusion of pollutants by leachate.

## 2. Methods and Results

### *2.1 Soil Sampling and Analysis of Particle size*

To analyze a particle size of soil, sampling point that are located at the distance of 1km, 10km, 20km from the nuclear power were choosen and soil samples were collected two samples, five sample, three samples, respectivly. After removing the weeds and organic matter in the soil surface, soil samples were dried at the room temperature. The analysis of particle size distribution of soil samples were performed by the basis of the Korean industry standard, KS F 2302.

### *2.2 Preparation of PEC Solution*

Polyelectrolyte complexes (PEC) was made of cationic polymer, Polydiallyldimethyl ammonium chloride (PDADMAC, approximately 50% solution, molecular weight = 100,000 ~ 500,000), and anionic polymer, Polyacrylic acid (25% solution, molecular weight = 240,000) or carboxymethyl cellulose sodium (CMC, DS = 0.9, molecular weight = 700,000).

To prepare the PEC solution, KCl and NaOH dissolved in water. PDADMAC added to the salt solution and then PAA or CMC ((-) / (+) ratio) was added slowly with stirring. When PAA added in the mixed solution of PDADMAC and salt, sometimes polymer particle may be proudct in mixed solution with changing white color. The polymer particles have to dissolve to obtain PEC solution completely.

## 3. Results

According to the analyzed results of particle size distribution of soil with the basis of gravel (> 4.75 mm), sand (0.075-4.75 mm), and silt & clay (<0.075 mm) most of soil samples composed of sand with the range of 72-90%. Table.1 show the ratio of sand, gravel, silt and clay of soil samples which were based on the analysis of particle size of soil samples.

Table. 1. Ratio of sand, gravel, silt &clay for the soil samples .

| Sample | Particle size distribution | | |
|---|---|---|---|
| | Gravel (>4.75mm) | Sand (4.75~0.075mm) | Silt & Clay (<0.075mm) |
| P1 | 6.85 | 81.47 | 11.68 |
| P2 | 2.04 | 88.88 | 9.08 |
| P3 | 5.54 | 87.06 | 7.40 |
| P4 | 6.58 | 85.94 | 7.48 |
| P5 | 1.87 | 86.58 | 11.55 |
| P6 | 21.34 | 72.40 | 6.26 |
| P7 | 1.95 | 81.24 | 16.81 |
| P8 | 6.42 | 81.80 | 11.78 |
| P9 | 3.85 | 90.97 | 5.18 |
| P10 | 6.83 | 77.03 | 16.14 |

The nature of soil samples were determined by using triangular diagram. Fig. 1. show the soil sampling points around nuclear power plant and the triangular diagram. As the classification of nature of soil, the seven samples are loamy sand, the two sample are sand, and the one is a sandy clay loam.

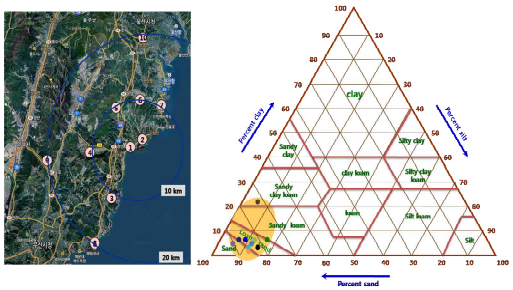


Fig. 1. Soil sampling points around nuclear power plant and triangular diagram based on the analyzed results of particle size distribution of soil.

Fig. 2 show the measurement device of leachate which were the column type with the diameter of 4cm and the height of 30cm. 40g soil with a grain size of 0.5 to 2.0 mm were mixed with 15-20mL PEC solution. Then put into the column and dried in the oven. In oder to measure the quantity of leachate, 40mL water pour in the column that was filled with non-fixed soil or fixed soil.

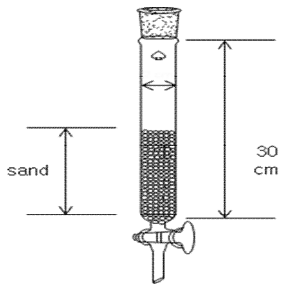


Fig. 2. Device of measurement for leachate that is the column type with the diameter of 4cm and the height of 30cm

Fig. 3 show that the quantity of leachate of fixed soil by PEC solution are more than that of the non-fixed soil because the hydrophobicity of fixed soil was increased by polymer. In the case of non-fixed soil, 15.2mL water were leaching and 24.8mL water was absorbed into the soil. On the other hand, in the case of fixed soil that mixed with the amount of the PEC solution of 15 mL and 20 mL, when the mole ratio of anion and cation is 0.5 leaching were 23.8mL 26.4mL, respectively. when the mole ratio of anion and cation is 0.2 leaching were 24.4mL 26.6mL, respectively.

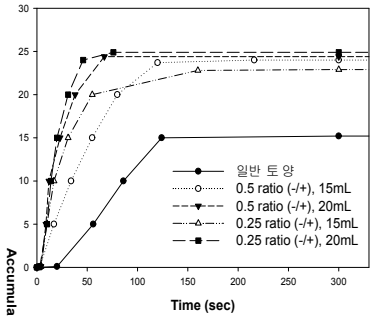


Fig. 3. The changes of leachate as PDADMAC/PAA molar ratio in a soil.

## 4. Conclusions

Most of the soil samples were composed of sand. However, the ratio of gravel, sand, and silt & clay were varied and depended on the sampling area. After the soil were fixed with polyelectrolyte polymer, the amounts of leachate in the soil were increased with increasing the hydrophobicity of soil. Because the ratio of soil will affected to the condition of soil fixation and the characteristics of leaching. leachate in the soil can be occured the secondary contamination.

In oder to obtan optimized fixation condition of soil, it have to considered various factors such as such as the effect of ion in the soil, pH and chemical componets of soil in the interaciton of soil and poylmer.

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